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CONCRETE WORKER'S REFERENCE BOOKS

Concrete Wall Forms

By A. A. HOUGHTON

Author of "Concrete from Sand Molds," "Ornamental
Concrete Without Molds," Etc.



Being Number 1 of this Series

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CONCRETE WALL FORMS

A PRACTICAL TREATISE

EXPLANATORY OF THE CONSTRUCTION OF ALL TYPES OF WALL FORMS, CLAMPS, SEPARATORS AND SPACERS FOR REINFORCEMENT. FULL DETAILS AND WORKING DRAWINGS OF AN AUTOMATIC WALL CLAMP ARE GIVEN, WITH THE OPERATION OF SAME ON ALL STYLES OF WALLS. FOUNDATIONS, RETAINING WALLS, PLACING FLOOR JOINTS, MOLDING WATER TABLES AND WINDOW LEDGES, AS WELL AS MOLDING FIREPROOF WALLS AND PREPARING FOUNDATIONS FOR CONCRETE WALLS ARE ALSO FULLY TREATED

By
Albert
A. A. HOUGHTON

Author of "Concrete from Sand Molds," "Ornamental Concrete Without Molds," Etc., Etc.



Fully Illustrated by Original Drawings

NEW YORK
THE NORMAN W. HENLEY PUBLISHING CO.
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FOREWORD

IT is the purpose of the writer to present in this series of books a complete explanation of various successful methods of concrete construction that may be employed by the beginner as well as by the more experienced worker. I shall endeavor to give the details of molds and ideas that are not covered by patents, such as may be easily and cheaply constructed; hence the reader is not compelled to purchase expensive patented molds before putting into practise the many successful types of concrete construction I have exhaustively described in this series. There is no practical value to the reader in explaining a patented system of construction, other than a few words on its merits, as the owners of same are always pleased to give this information; hence in going outside the beaten track of concrete authors and presenting ideas, systems, and molds that are practical, successful in operation, and, above all, easily and simply constructed, I trust that I have merited the sincere gratitude of all fellow workers in the concrete field who seek such information.

Yours very truly,

A. A. HOUGHTON.

PREFACE

WITH the increasing demand for monolithic concrete walls, instead of block construction, this treatise will be of value to the worker who constructs the forms or centering for this work. The simple and effective method of bracing wood forms, as well as the many styles of easily made wall-clamps, separators, and wire ties, will save much expense of construction, as well as time when the regular clamps are not available. The automatic wall clamp, which is fully described and illustrated, solves the problem of easily building monolithic concrete walls, with a continuous air-chamber in same. This clamp is entirely unlike those on the market, and in many points is superior to those restricted by patents. The cost of this form of clamp is low, as it can be built by the worker or any blacksmith. It saves time in the work, as the simple raising of the form releases the centering entirely from the concrete; and when again lowered, the form is automatically locked into position for filling. This clamp is adjustable for any width of wall desired, and is also of the greatest value in constructing circular walls or angles in the regular wall. The hopper, described for use with

same, makes the rapid placing of the concrete a simple matter.

The placing of door and window frames, projecting ornaments, using plaster molds with wood forms, and the method of molding water-tables and window-ledge will also be of use to the worker in every-day construction.

Among the many other valuable ideas illustrated, the easily placed spacer for reinforcing, economical system of constructing walls, joining sections of wall, molding concrete furring strips so as to perfect a fireproof wall, placing floor beams and joists, and the illustrations of the usual types of concrete retaining walls are worthy of mention.

The writer has endeavored to explain every part of this subject in the plainest language, and from the view-point of the needs of the worker who wants ideas that can be employed without purchasing expensive equipment, and which will give as good service. In this regard this book should be of the greatest value to every contractor and concrete worker.

A. A. HOUGHTON.

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CONCRETE WALL FORMS

THE construction of forms or centering in which the concrete is to be placed for molding any style of wall, requires some skill and forethought, otherwise there will be an unnecessary waste of material, or the forms will be lacking in rigidity, and as it may be noticed with many pieces of work, the forms have warped or spread, thus causing unsightly projections on the face of the molded work.

With proper bracing a $\frac{7}{8}$ " board is often ample as the material for the face of the centering; this has given even better results and a more perfect wall face than 2" planks that were insecurely braced. The care of every worker should be to plan his centering so that the weight of the concrete and the pressure exerted by tamping cannot in any manner displace the molds or forms, yet to permit the easy placing of the concrete and access to every part of the wall for tamping, or puddling, if a slush mixture of concrete is used. To accomplish this result, requires much more than the often haphazard method of constructing forms for concrete walls of every class.

BRACING WALL FORMS

The form of brace shown at A (Fig. 1) makes a very strong and secure brace, and gives the greatest

rigidity to the centering with the least use of lumber. For walls of the usual size 2 x 4" lumber may be employed in constructing this brace, as well as the upright and horizontal pieces to same. When the horizontal strip is cut one-half the length of the upright strip, the size of same will permit its use on many jobs where a longer horizontal piece would be in the way of the workers. The brace may be morticed into the other two pieces, or spiked to same in the manner illustrated; or bolts may be used, the practice of cutting the brace on a miter and toe-nailing to the upright and horizontal pieces is not to be recommended, as the nails usually split the wood and do not prevent it from giving or slipping when subjected to pressure.

This form of brace is anchored to the ground with a stake driven at the end of the horizontal 2 x 4" piece; the weight of the concrete placed in bottom of form holds same rigidly against the stake in ground, and thus prevents the upper part of form from spreading when filled and tamped.

Another style of this form of brace is shown at *B* (Fig. 1). This shows the adaptability of same to almost every class of wall form, as the braces permit the easy access to the footing courses of wall, for placing and tamping the concrete; there is also a solid support to the upper form with the least possible use of lumber. By referring to the illustration at *B* (Fig. 1), the construction of this form of brace is easily understood, and can then be applied to nearly every type of wall to be constructed.

Another advantage of this method of bracing is the easy removal of the forms or centering from the work; the drawing of the stake at end of the horizontal piece permits the forms to be drawn back away from the wall, without the danger of breakage, as where nails must be drawn out before the lumber can be released.

BRACING ANGLES IN THE CENTERING

The illustration at *C* (Fig. 1) shows a successful method of bracing angles in the centering, in addition to the other form of brace explained. Thus in the molding of piers or a buttress in the wall the boards may be rigidly held at the corners, and yet be easily removed when the centering is to be removed. The employing of angle-irons, which are made of the ordinary strap-iron and drilled for screws, is fully shown in the illustration at *C* (Fig. 1); this is not only adaptable for the inside corners, but is applied as readily to the outside corners, using the same irons. The one-inch width of iron is the best to use, and this is cut 6" or 8" in length and bent at right angles, in the center. This permits enough of the iron to project on to each side of the corners to secure a good hold for the screws used to fasten same. In taking down the centering these screws are easily removed without injuring the concrete, an advantage not possible where nails are to be drawn.

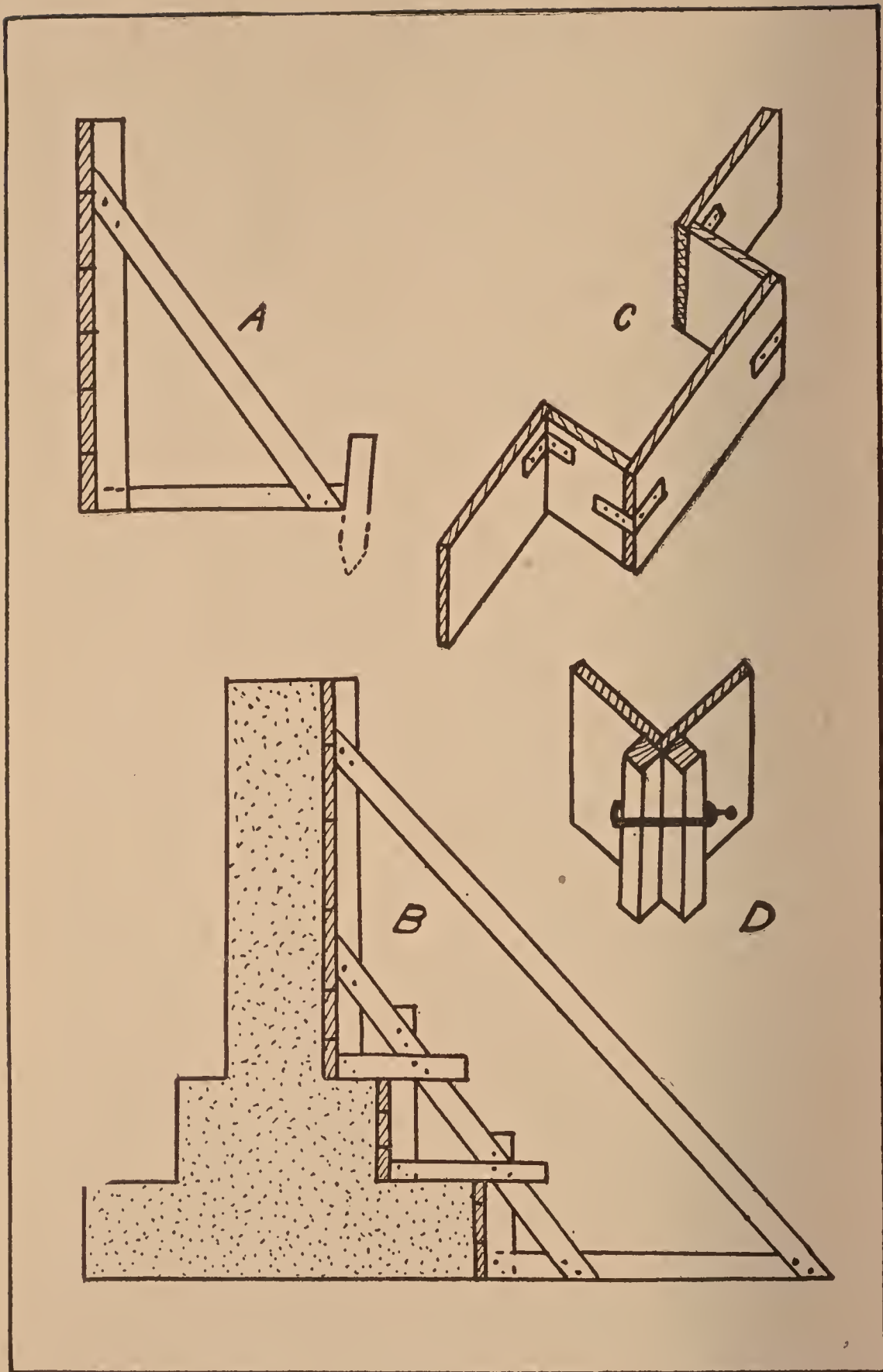


FIG. 1.—Braces and corners for wall forms.

FASTENING CORNERS WITH CLAMPS

Another method of fastening corners is illustrated at *D* (Fig. 1). This permits the more rapid removal of the centering, but is not as secure a fastening as the method formerly explained. The two strips nailed upon each board at the corner, with one strip overlapping the outside board, are simply held with a clamp, and thus are quickly removed. A disadvantage of this method is the fact that the tightening of the clamp will often draw the two strips on ends of boards together, no matter how securely nailed; this can be remedied by inserting a beveled or triangular wedge between the two strips as the clamp is applied, thus preventing their being drawn out of position.

FOUNDATIONS FOR WALLS

In the construction of wall forms attention must be given to the load the wall must carry, so as to give it the necessary strength, the size and form of footing, and the soil upon which this footing must rest; otherwise the best efforts in wall construction cannot be anything but a failure.

The most secure foundation for a wall is of course one of rock, as the average crushing strength of our softest sandstone is 2,894 pounds per square inch, and from this varying to the highest crushing strength of granite, or 28,000 pounds, to the square inch, thus insuring that any properly embedded rock foundation

is ample to carry any load that is desired to place upon same.

A gravel foundation is the next best in point of weight-bearing value; when placed so it cannot spread laterally, a well-bedded gravel foundation will carry a load of from 6,000 to 8,000 pounds per square foot, and when this is very well cemented together the load has been safely increased to 16,000 pounds to the square foot.

The safe load for soft clay foundations is from 2,000 to 4,000 pounds to the square foot, and when this is well drained, so as to secure a foundation of dry clay, the load may be increased to 8,000 and 10,000 pounds to the square foot.

Where it is necessary to construct on a soft soil, as quicksand or mud, every effort should be given to making the foundation more dense by sinking piles or filling with a good rock ballast. Where the soil is in a semi-liquid state, the safe loading for such soils cannot be given at more than 500 to 1,000 pounds to the square foot.

In planning the footing for your wall it should be remembered that the center of wall or point of pressure should be directly over the base of the footing, so as to distribute the wall load equally over the footing course. Where this is not possible the footing course must be reinforced so as to bring the downward pressure of loading over the upward pressure of the footing. The footing course should also be of ample structural strength to distribute the load evenly over

the solid foundation. In determining the width of the footing course the area of same must be such that the total load it must carry, divided by the area of the footing course, will not be greater than the allowable pressure per square foot on the soil or foundation, upon which the footing must rest. By employing these simple methods the width of footing course is easily determined for any wall that you wish to erect, and your centering or forms built accordingly will permit the work to be a success.

The width of wall must also be determined by the load it must bear, and for safety should be in excess of any possible loading to be placed upon same; the average compressive strength of 1:2:4 concrete at 40 to 60 days is used by many successful contractors as a safe-bearing load, and is from 2,000 to 2,300 pounds per square inch; of 1:2½:5 concrete is from 1,800 to 2,000 pounds per square inch, and a mixture of 1:3:6 concrete will give a compressive strength of 1,500 to 1,800 pounds to the square inch. The strength of course will vary according to the success attained in mixing and placing same, as well as in the temperature at the time of the curing of the work.

The weight of a cubic foot of concrete varies from 145 to 155 pounds, with an average weight of 150 pounds, as the usual basis in estimating the weight of the wall.

Where the load can be so placed that the compressive strength or ability of the wall to resist a down-

ward pressure is all that need be considered, the design is more simple, but in event the load demands that the wall resist a lateral pressure or thrust, as with beams and joists, the average wall must be reinforced to bring the tensile strength of the concrete up to more than equal the load. The tensile strength of concrete that has no reinforcement is usually estimated at one-tenth the compressive strength, thus requiring in almost all structures ample reinforcement to hold against the floor-load, as well as to increase the shearing strength to bear the loading safely.

The shearing strength, or ability to withstand a cutting or sliding force, similar to when a bolt or rivet is tested for shear, is estimated at about one-half the compressive strength of the concrete without reinforcement; this should be increased by ample reinforcing until there is no doubt of the strength of the wall to withstand any possible loading it must carry.

The contractor should be able to correctly determine these points, as in the construction of the wall forms it is very often necessary that the conditions demand a change in the original plans to meet with positive safety the various differences in foundation and loading that are found at the last moment. Concrete is an ideal building material when properly handled, but it cannot be expected to accomplish a perfect success when it is not given a fair chance. The majority of failures can be directly traced to an

imperfect knowledge of this material — “rule of thumb” guesses at proportioning, mixing, and the loads placed upon the work without regard to foundations or strength.

EASILY MADE CLAMPS FOR WALL FORMS

A number of easily constructed clamps for holding the centering are illustrated in Fig. 2; the simple board clamp shown at *A* (Fig. 2) is made by nailing six pieces of lumber together in the form shown, and then drawing up the centering to make a tight joint by using two wedges of hardwood, as illustrated at *B* (Fig. 2). This makes a very cheap, and for some work that does not require exactness, satisfactory means of clamping the forms together.

CLAMPS FOR USE ON PIERS

At *C* and *D* (Fig. 2) are shown two clamps for use on piers or columns, or any square forms that permit their use. The former is constructed by nailing a cleat at each end of a strip of lumber, that is enough longer than the width of centering to allow the strip placed at right angles to same and the cleat to go upon each end; the four strips are then assembled in the manner shown at *C* (Fig. 2), around the centering, and tightened with wood quoins or wedges driven between the centering and the wood strips of clamp. The clamp illustrated at *D* (Fig. 2) is made by connecting with two iron rods, threaded for nuts at each end, two notched strips of lumber, slightly

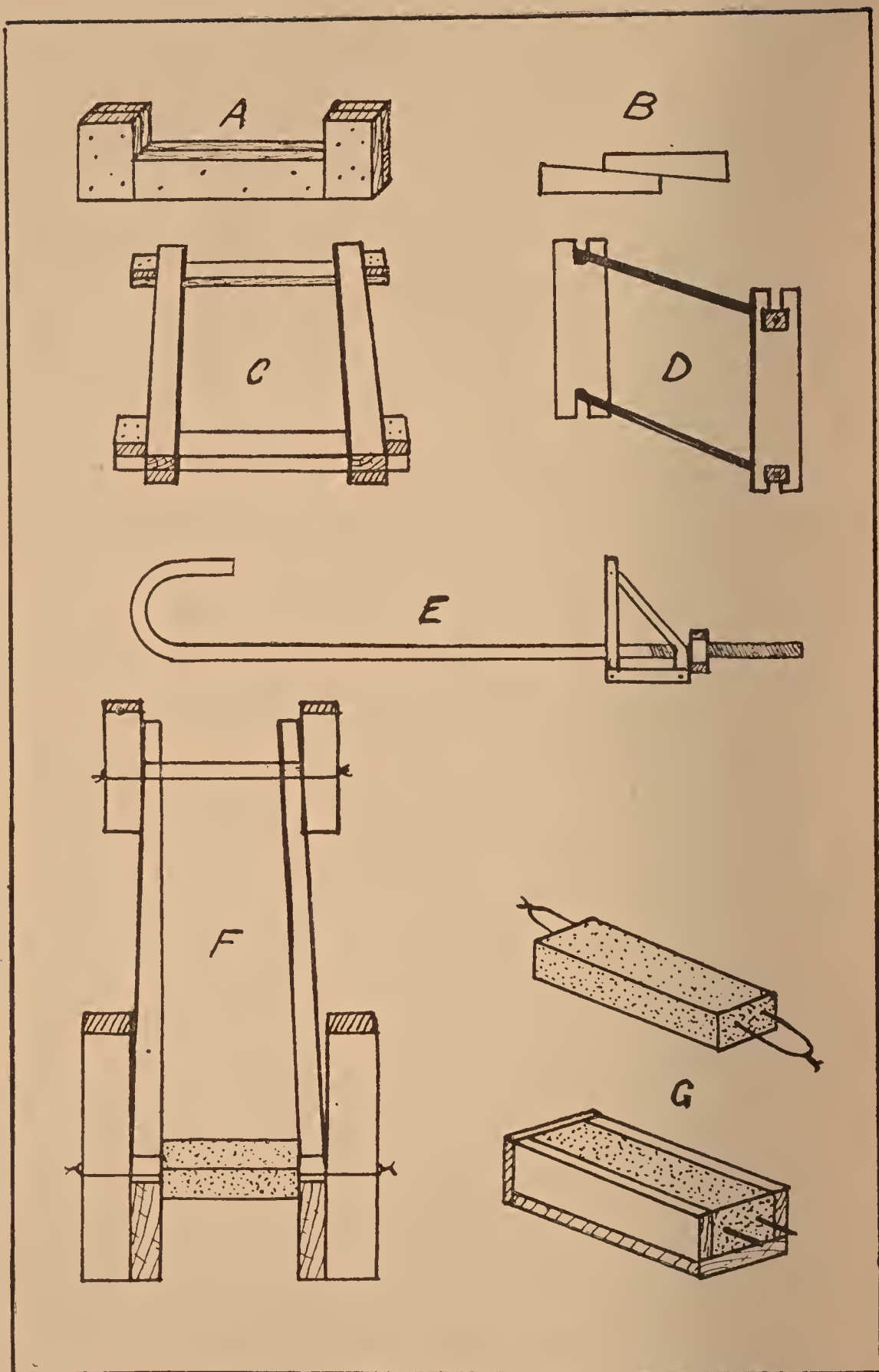


FIG. 2.—Wall-clamps and separators.

longer than the centering is wide. This permits the clamp to go entirely around the centering and hold same securely from spreading with the pressure of placing and tamping of the concrete.

AN EASILY MADE SUCCESSFUL CLAMP

A very effective form of clamp is shown at *E* (Fig. 2). This may be made from a section of 1" iron gas-pipe. This is bent at one end in a half circle, as illustrated; the opposite end is threaded, and a sliding standard made to slip over the pipe, and thus be pressed up against the centering on this side by simply tightening the nut on the threaded end of pipe. The advantage of this clamp is that it can be employed for very wide forms, as the cheapness of construction enables its use for such widths where it would be impossible to purchase a clamp of the right size for the purpose, also the fact that by threading the pipe for one-half its length or more the clamp permits of a very wide range of adjustment, making it doubly valuable to the contractor who is called upon to erect centering for many different jobs.

WIRE TIES

Wire ties make a cheap method of holding the planks of centering in position. These may be employed with or without separators, as shown at *F* (Fig. 2), where employed without something to hold the planks at the proper distance apart, the mortar must be placed against the sides of the planks first,

to press them outward to the proper width, where they are held by the uprights around which the wire ties have been fastened. The wires must remain inside the concrete, and are cut off close to the surface of the wall when forms are removed.

MOLDING SEPARATOR OF CONCRETE

The separator shown at *G* (Fig. 2) is molded of concrete in a square box form, through which two greased rods of $\frac{1}{4}$ " iron have been placed. This permits these rods to be removed, leaving a space molded for placing the wires of tie or bolts as may be employed. As these are inserted after the separator is molded, they may be as easily removed from the finished wall, thus leaving no unsightly ends of wires on the surface. The separator, or small block of fully cured concrete, is placed between the planks in the manner shown at *F* (Fig. 2), and the wire ties or bolts passed through same and around or through uprights, thus holding the centering rigidly in position and permitting the planks to be placed upon each other as high as the wall is to be built.

This form of construction is very useful where the walls are to receive a coat of plaster, which will cover up all ends of wire ties and the holes through the concrete where the wires or bolts were placed.

The separators, before being used in the wall, should be brushed with a stiff wire brush, so as to remove as much of the coating of cement on the surface as possible, and thus by exposing the aggregate

secure a better bonding between separator and wall than would be possible if this was not done.

WASTE IN USING WOOD FOR WALL FORMS

In the employment of wood as a material for wall forms there is always a great amount of waste, as the lumber taken from one job will not work into another without cutting; hence, with every time the lumber is used more of it must be wasted to secure proper construction. This waste, in connection with the time and expense needed to construct wood centering and remove it from the work, consumes a large portion of the profits in this part of the construction.

ADVANTAGES OF USING ADJUSTABLE WALL FORMS

Again, in consideration of the fact that the wood form is not available to mold with success anything but a plain wall, without air-chambers or spaces, it can be readily seen that for all work, wherever possible to employ, the adjustable metal form will entirely supersede the use of wood as a material for wall forms. This, when of the right construction, enables the concrete to be placed in a fraction of the time required where a wood form must be used, then by being adjustable to all widths of wall the same form can be employed for every job; as well as erecting a superior type of wall with air-chambers, etc., not easily possible to secure with the old style centering.

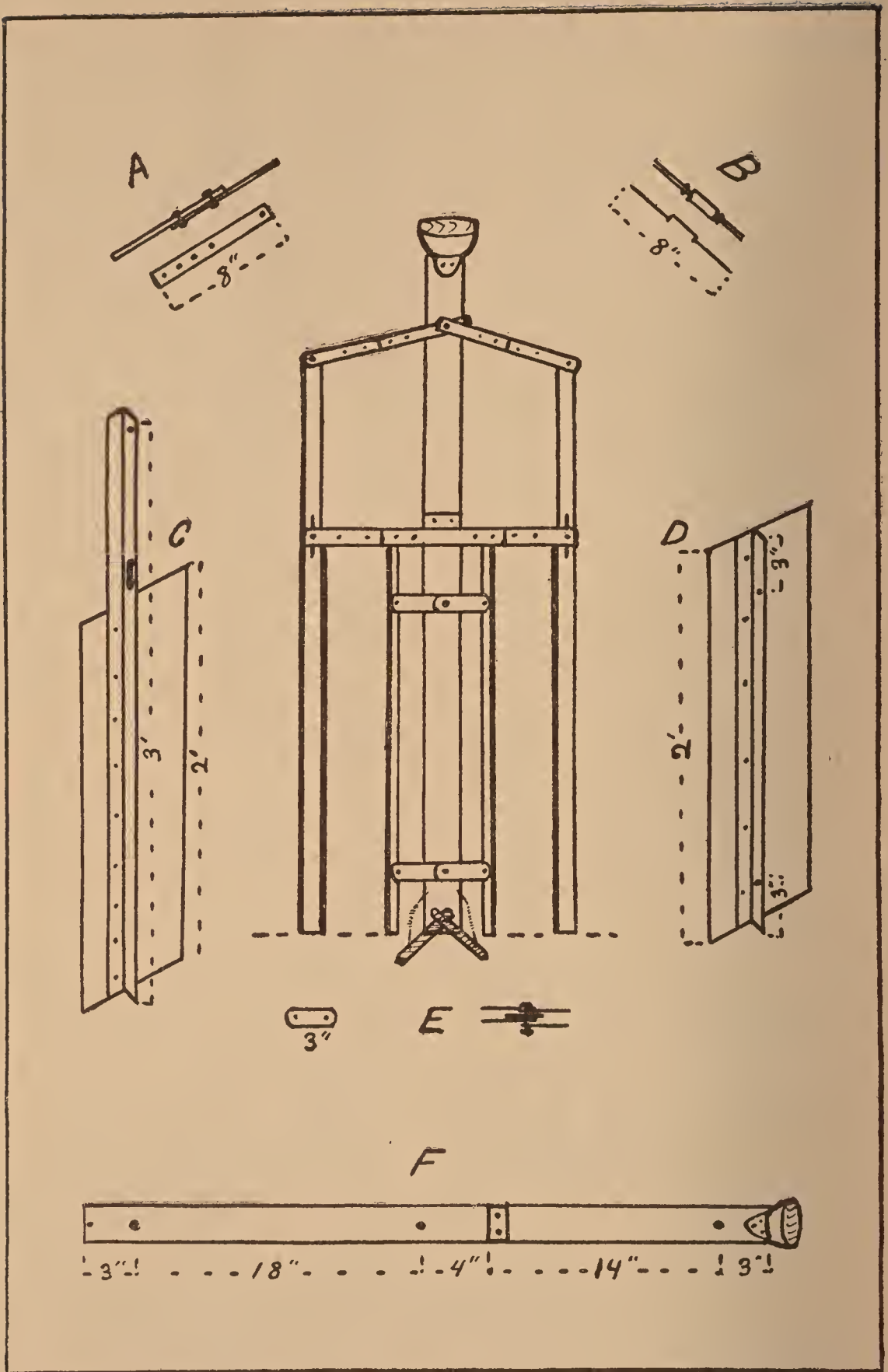


FIG. 3.—Details of construction of adjustable wall-clamp and metal forms.

THE AUTOMATIC WALL-CLAMP

The automatic clamp illustrated in Figs. 3 and 4 is very easily constructed from different widths of strap-iron, or patterns may be made and the parts molded in cast iron, as the contractor may choose; the saving of time and waste on one job being very nearly equal to the cost of constructing the number of clamps required.

EASE OF OPERATION

As will be noted by referring to the illustrations, the simple lifting of the forms draws upward the center bar of the clamp. This slides through the cross-bar that rests upon the top of centering and draws the two sides of core together, away from the wall, so they can be lifted without touching the concrete. The same action draws the two outside forms together, at the top, as shown in Fig. 4, thus pressing the outside centering away from the outside of concrete wall, so that when lifted the entire form is free from the wall at every point.

When lowered again in position it is automatically locked, ready for filling with concrete in a moment's time.

The materials that may be used for the molding surface are varied. The best is the sheet metal of any strength that will not permit it to bend easily. This should be reinforced at even distances apart with light angle iron, riveted to same, to give it

sufficient rigidity for the work. The placing of the clamps should vary from four to six feet apart, according to the rigidity of the centering used. Boards nailed together may also be employed as the material for the molding surface, with the clamps attached to same with screws or bolts. This makes a heavier form than where the sheet metal is employed, but works as successful, when the wood is treated so it will not warp under the continuous service such a form will have to withstand.

CONSTRUCTION OF CLAMP

The complete clamp is shown assembled in the center of the illustration at Fig. 3. The different parts are made in the following manner. At *A* (Fig. 3) is shown the single and assembled parts of one of the upper bars that draw the outside molds away from wall. To make, two pieces of 1" strap-iron are cut 8" long, at one end of each one $\frac{3}{8}$ " holes are drilled, and down the length of same $\frac{1}{4}$ " holes are drilled 1" apart. The two pieces are bolted together, and by removing these bolts and sliding the two parts together the different widths of wall are partly secured. Four pieces, or two assembled parts, are made of this for each clamp.

At *B* (Fig. 3) is shown the horizontal bar that rests on the centering and through which the central bar slides when form is lifted. Two pieces are cut for this 8" long, and these are bent in the center so when the two parts are placed together they form a

bushing for the central bar to slide through. The two parts are riveted together upon each side of the bushing, and in the ends, outward from rivets, $\frac{1}{4}$ " holes are bored to which the extensions are bolted. These are placed 1" apart to permit adjustment. Two bars are now cut 8" long and finished with holes as specified for those at A (Fig. 3). These are bolted to the bushing on central rod, and also to the two uprights that carry the centering for outside of wall.

In bolting the adjustable bars together it is important that they are lapped sufficient, so that two bolts can be used, that the bar will be rigid and hold the centering properly in position.

OUTSIDE CENTERING

The construction of the outside centering or molds is shown in detail at C (Fig. 3). A length of 1" face angle-iron is cut 3' long and riveted to the centering, if sheet metal is used, or attached with screws or bolts if boards are employed. The width of the centering is 24", thus allowing the angle-iron to project above same 12". At a point $\frac{1}{2}$ " above the top of centering, a slot is cut in the projecting face of the angle-iron to receive a $\frac{3}{8}$ " bolt and allow same to easily slide the length of the slot, which is cut $2\frac{1}{2}$ " long and receives the bolts for the connecting-bar, just above centering. A $\frac{3}{8}$ " hole is also drilled in the end of the angle-iron, on the same face as the slot is cut, as shown in illustration.

CONSTRUCTION OF CORE

The construction of the centering for core form is illustrated at *D* (Fig. 3). This is 24" wide and across same a section of $\frac{5}{8}$ ", or $\frac{3}{4}$ " face, angle-iron is riveted. This is exactly 24" long, to equal the width of the centering. At a point 3" from the end of each projecting face of the angle-iron, a $\frac{3}{8}$ " hole is drilled, to which the connecting-bars of collapsible core are to be bolted.

These connecting-bars to collapsible core are shown at *E* (Fig. 3). At the left is shown the detail of bar. This is made 3" long, with the two centers of the $\frac{3}{8}$ " holes drilled at each end of same, exactly $2\frac{1}{4}$ " apart, if a core of 6" in width is desired. Where the core is demanded to be 4" in width, when extended, these connecting-bars should have the holes drilled $1\frac{1}{4}$ " apart, center to center.

ASSEMBLING THE CONNECTING-BARS

The method of assembling the connecting-bars to collapsible core is shown at the right of *E* (Fig. 3). Two of the bars are lapped on each side of the central bar and bolted to same with the one bolt, which should permit the bars to work freely upon same. The opposite ends of connecting-bars are bolted to each side of the projecting face of angle-iron, that carries the centering for core. The use of two bars on each side is advised, as it will secure a more rigid form, and as they must work freely on the bolts one

bar would not hold the forms as successfully. Strap-iron, 1" wide, should be used for these connecting-bars.

At *F* (Fig. 3) is shown the central bar of the clamp. This is made from 2" width of strap-iron 3', 6" long, to one end of which a handle is riveted, or a ring attached if the forms are to be lifted with a derrick.

At the opposite end of the bar a $\frac{3}{8}$ " hole is drilled in same, exactly 3" from the end. Exactly 18" from this another $\frac{3}{8}$ " hole is drilled. These are to be employed in bolting the connecting-bars of core form to the central bar, as shown in the assembled clamp.

At a line 4" above the last hole drilled, a short lug, or piece of strap-iron, is riveted to the side of the central bar. This rests against the bushing on central bar and prevents the core form from sliding down farther than the point at which it is fully extended, an essential part of the construction, as otherwise the form would collapse in one direction as easily as in the manner desired.

At a point 14" above the lug, or 18" from the center hole, another $\frac{3}{8}$ " hole is drilled, to which the adjustable bars for the top of clamp are bolted.

At the bottom of the central bar a $\frac{1}{4}$ " hole is drilled, and to this two bars of $\frac{3}{4}$ " width of strap-iron are bolted. These are 4" long and sharpened at one end to embed into the concrete wall on each side of the air-chamber, when the form is lowered into position for placing the concrete. This prevents the form

from slipping down over the work just molded. Two light coil springs, attached to these bars and to the central bar, will hold them in position against the sides of wall and also permit them to fold together, when drawing the mold as shown at A (Fig. 4).

OPERATING THE FORMS

In Fig. 4, at the left, is shown the mold in the act of being lifted from the concrete wall. The core mold, or form, is collapsed and the outside centering drawn outward far enough to completely clear the wall, the slots in the outside angle-irons permitting the cross-bar, at top of centering, to slide upward so it will not interfere with the centering.

The drawing at the left of Fig. 4 shows the mold lowered into position again, with the lug on sliding bar resting against the bushing on cross-bar and thus holding the form from slipping. The two bars at bottom of center bar embed into the wall that has been molded, and not only prevent the form from slipping down, but also hold up the collapsible core form, if it has any tendency to slip downward. Where uprights are erected plumb beside the wall, to be used as guides in raising and placing the forms, the forms may be raised to the top of wall and metal ties to join the two walls inserted under same, thus tying the walls at every course of two feet in height.

The form may also be raised for a part of the height of centering, thus for instance lowering it so 6" of the wall that has been molded projects above

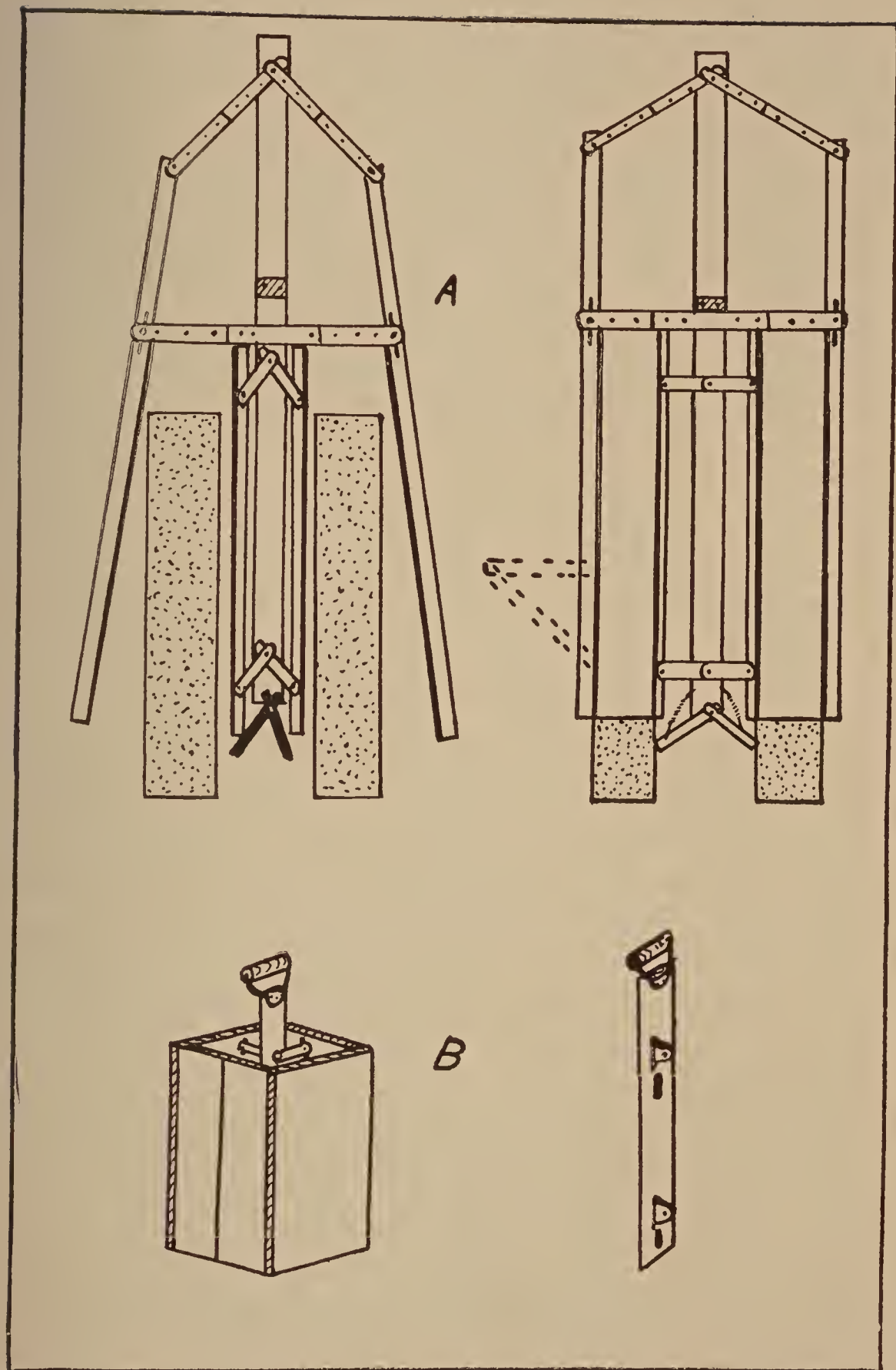


FIG. 4.—Operation and uses of adjustable wall-clamp.

the bottom of forms. This makes less possible danger of the forms being displaced by careless handling of concrete.

The centering may be any height you wish, by simply extending the length of the clamp in the proportions given. The height of centering should be planned with a view to easily raising and lowering same, which could not be done without a derrick if they were constructed too large.

ADJUSTING THE CLAMPS

The form of clamp shown permits the molding of two walls with a 6" air-chamber between same. These walls are adjustable to any thickness from 3" to 10", and it also permits one wall to be molded 6" in thickness and the other 3", or any adjustment in this regard you may desire. This gives a total thickness of wall, including the air-chamber, of from 12" to 26", as you may wish to adjust same. By employing 1 $\frac{1}{4}$ " connecting rods or bars to the collapsible core form, the air-chamber can be made 4" wide, thus permitting a total wall of from 10" to 24" in width, including air-chamber, by this adjustment. The forms are very quickly and easily adjusted to any of the ordinary widths of hollow monolithic wall you wish to erect, in the manner previously explained.

USE OF SHEET METAL FOR CENTERING

By employing the pressed sheet metal as a molding surface for the outside centering, the walls can

be finished in imitation of brick, or blocks of stone. The inside walls may be molded in ornamental designs, by employing the pressed steel ceiling plates as a molding surface. In this manner many ideas of the worker may be carried out to suit his wishes or the requirements of the job.

The form permits any reinforcement to be placed that you may wish to employ in the wall, as it is always within easy access of the workers.

BUILDING A HOPPER TO MAKE PLACING OF CONCRETE EASIER

By cutting two boards to just fit between the wall-clamps, and joining these together at right angles so they will rest upon the core form, the concrete will be prevented from dropping down into the air-chamber. By extending the outside centering up 6" to 8" above the core, and also employing this board form, a hopper is made into which the buckets from the derrick can be dumped with the assurance that the concrete must fall into the position desired. This will be found a valuable time and labor saver on large construction work.

BRACKETS FOR STAGING

Where the forms are to be lifted with a derrick, the outside angle-irons may be made of 2" width of face; to these are bolted brackets, as shown by the dotted lines at A (Fig. 4), thus permitting staging boards to be laid upon these brackets, for the use of

the workers in tamping and placing the concrete. To permit this the brackets must be placed on the inside of wall of building, and the forms extend entirely around the structure so the weight of the workmen will not displace the centering. Then, with metal ties between the two walls, every time the forms are raised, the centering may also replace the necessary staging, as the sections of centering are joined by bolts, when being filled, hence they are not easily displaced.

The clamp may be easily adapted to the molding of any angle in the wall, also to circular forms, as towers, etc., by simply bending the sheet-metal centering into a circular form, or to conform to the angle that it is desired to construct in the wall. As will be noted, the clamp is adjustable to all these requirements, and will fill the needs of thousands of contractors who can employ an easily and cheaply constructed clamp of this nature, of which there is nothing like it on the market to-day. As this is not patented, and the idea is original with the writer, it may be constructed by anyone.

APPLIED TO CORE FORMS

This principle can also be adapted to core forms for concrete blocks, concrete piers with hollow cores and chimneys. The simple manner of construction is shown at *B* (Fig. 4). To allow the four sides to be fastened to the one center-bar, a projecting lug must be fastened at top and bottom upon each side of the

bar. These are drilled for the connecting-bars to be bolted to same, which are fastened to the inside boards or parts of core. The two slots cut in center bar, just below these lugs, are to permit the connecting-bars to be bolted to same for the two outside boards or sides of core. Thus when the center-bar is lifted with the handle, the two inside boards are drawn to the center of form or folded inward, as they are hinged in the middle to permit them to fold out of the way of the two outside boards. The slots in the center-bar allow the bolts through connecting-bars to drop to the bottom of slot, hence the lifting of the center-bar does not draw upon the outside boards until the center-boards have been folded inward out of the way, then the outside boards fold or collapse, thus allowing the form to be released from any core with the greatest of ease and rapidity.

THE BEST METHOD OF PLACING FLOOR-JOISTS

One of the best and easiest methods of placing floor-joists is shown in Fig. 5. This is easily arranged with the adjustable wall forms just described.

As shown in illustration, the forms for the inside wall are adjusted to mold a heavy inside wall. This is planned so at the point each floor is to be placed a step is arranged for the floor-joists to rest upon, and the inside wall diminished in thickness accordingly. This gives a greater strength than the use of hangers or the molding of a recess in wall, as a resting-place for the floor-joists or rafters, where the walls are

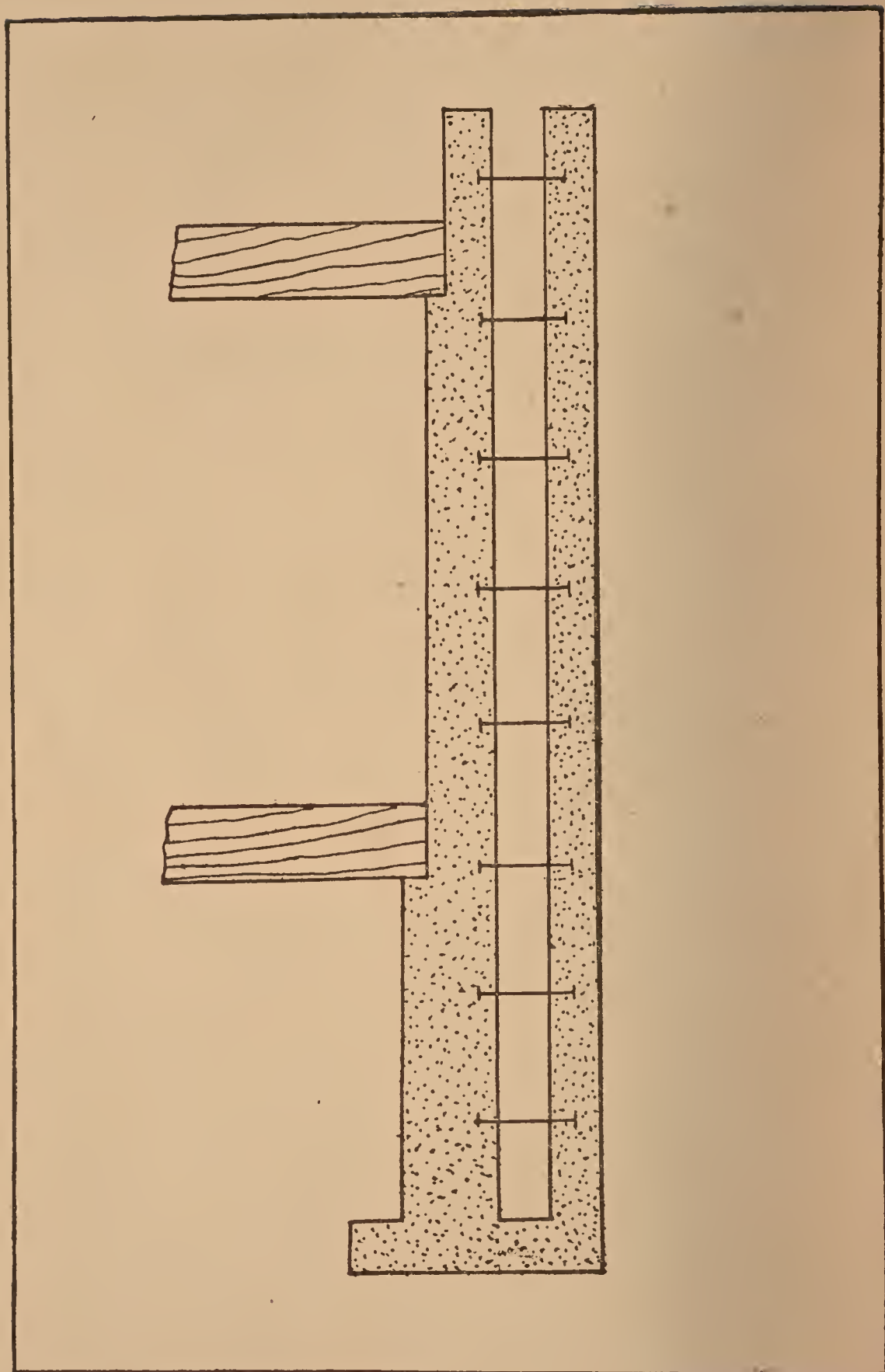


FIG. 5.—Molding steps or hangers in wall for floor-joists.

to be constructed above the roof, as in factory or mill construction where a flat roof is employed. The easy adjustment of the wall-clamps makes it possible to employ this form of construction without the necessity of reconstructing the forms, other than the simple adjustment of same for the new thickness of wall.

The use of metal ties is also shown in Fig. 5. These are placed in the wall as fast as the forms are lifted, and make a very successful method of tying the two walls together. Any of the usual types of metal ties on the market can be employed with these adjustable wall forms, or the contractor may use short pieces of strap-iron, heavy wire, etc., that is bent at each end, to make a secure lock in the concrete walls.

PLACING OF DOOR AND WINDOW FRAMES

An excellent method of placing door and window frames, as well as forms for arches, etc., inside the wall forms, is shown at A (Fig. 6). Two boards, or sections of the wall forms, are removed for the width of window, door, or arch, as illustrated, and a board placed upon each side of the opening, on outside of forms. The frame may now be set between the wall forms and held in position by clamps, adjusted in the manner illustrated.

This permits the frame to be accurately placed and easily moved to get it perfectly plumb, as the clamps may be loosened slightly to permit the frame

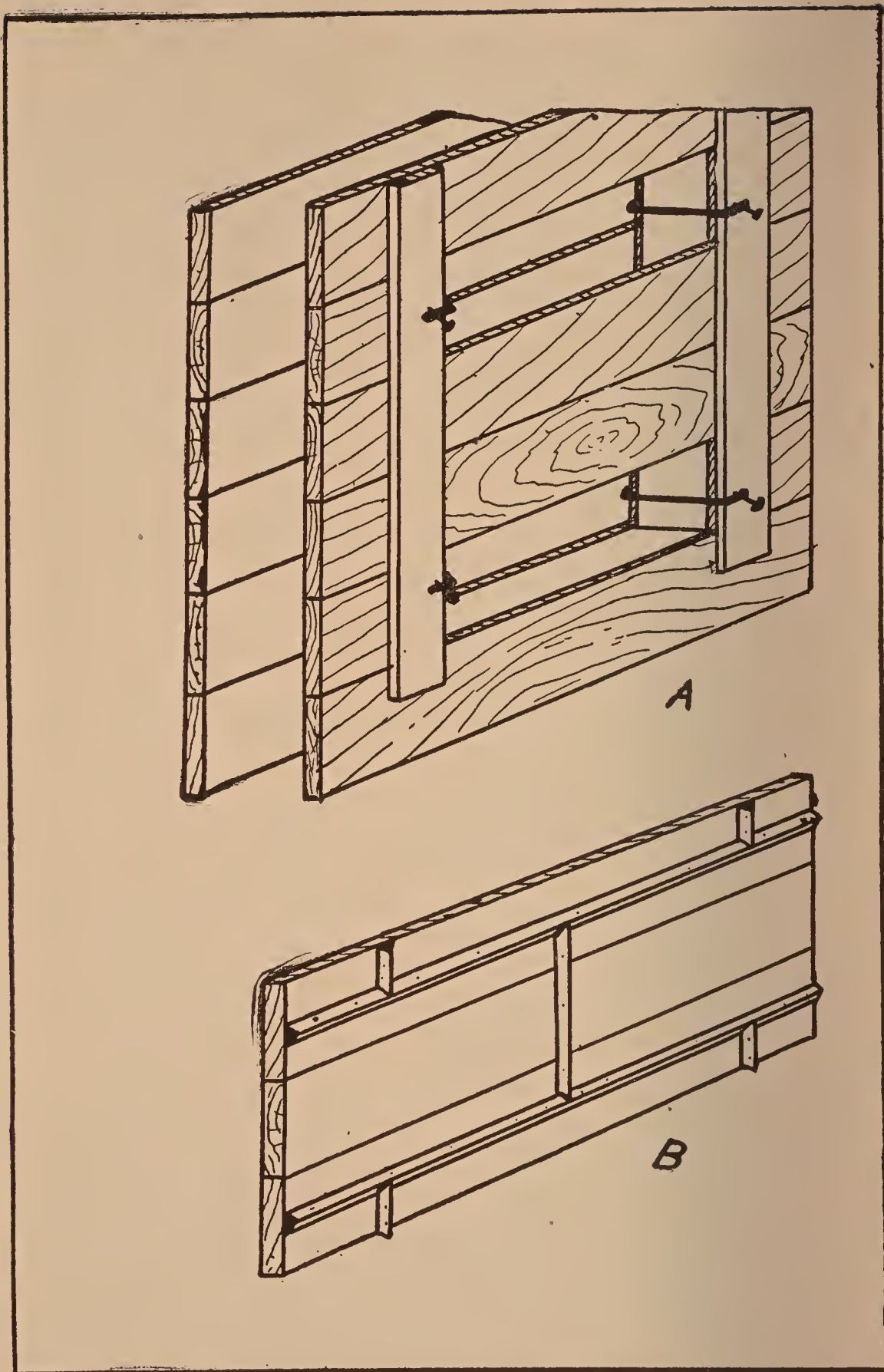


FIG. 6.—Placing door and window frames, and marking wall into blocks.

to be driven in any direction the adjustment demands. This is far more rapid and successful than when nails and screws are employed to hold the frame in position.

MARKING WALL INTO BLOCKS

The marking of the molded wall into blocks is often desired. This may be easily secured when the concrete is placed by nailing to the centering small triangular or bevel strips of wood, equal to the size of the lines you wish. These are divided into the size of the blocks you desire, in the manner shown at *B* (Fig. 6), and thus imprint into the concrete, as molded, the lines of the bevel strips, imitating mortar joints.

MOLDING WINDOW-LEDGE WITH WALL

It is often desirable to mold a window-ledge at the same time the wall is placed, hence the simple method shown at *A* (Fig. 7) will be found of interest.

The centering is cut the width of ledge, at the point it is to be placed, and upon the outside of wall forms a strip is nailed, that is equal to the projection the ledge is to have when completed. At each end of this strip a small block is fastened, as illustrated, and a board fastened to the outside of these blocks and strip. This provides a projecting space for the placing of concrete, and may be adapted for the molding of water-tables, or any form of this type you may desire.

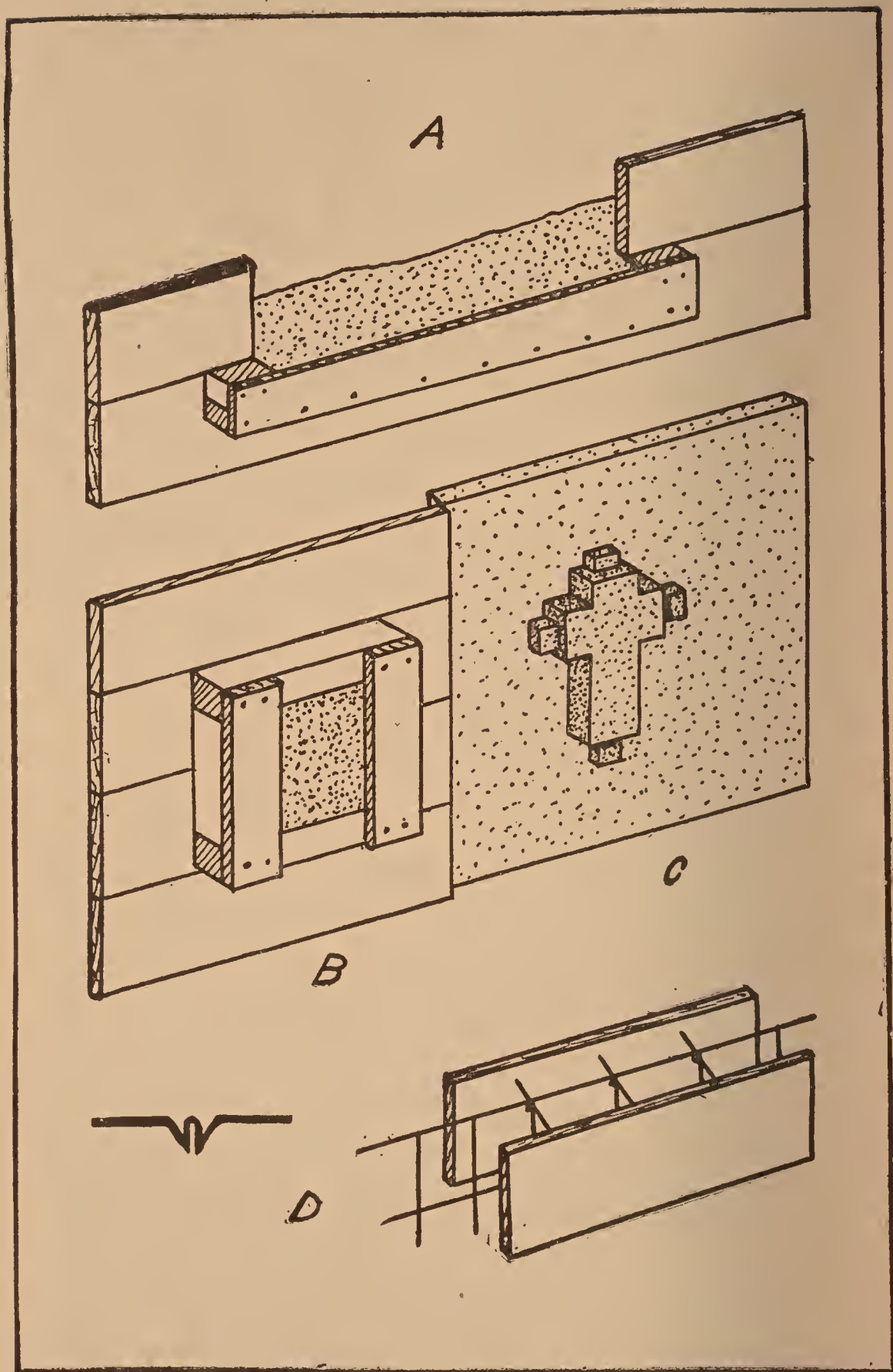


FIG. 7.—Molding water-tables and window-ledges, wall ornaments and spacing reinforcement.

USING PLASTER MOLDS WITH WALL FORMS

At *B* (Fig. 7) is shown the method of employing the use of plaster molds in connection with wall forms, to mold any special ornament on the face of the wall.

An opening is cut in the centering of the size of the plaster mold, and a box is attached to the wall form at this point, so as to permit the plaster mold to go inside same where it is held by two cleats nailed over the back of plaster.

This permits the plaster mold to be removed in advance of the removal of the wall centering, so as to lessen the danger of breaking the plaster mold and also to allow the ornament to be pointed up, where any defects in molding occur. If this is done before the concrete in wall has set over twelve hours the mortar added in pointing will bond more securely to the face of ornament, and make the work of pointing same easier and more successful.

MOLDING PROJECTING WALL ORNAMENTS

At *C* (Fig. 7) is shown one design of projecting wall ornament, that is easily molded with the wall. The outline of the ornament is cut into the centering, or boards used for the wall form, then, by placing strips around the edge of this opening, as described for the window-ledge, any desired projection to the ornament may be secured. These strips are best fastened to centering with screws, so as to be the

more easily removed from the forms. The face of ornament can be molded by a strip of sheet metal, of any kind, or a board fastened to the strips, around opening, with small screws.

In this manner the ornament illustrated, and any bracket or similar projection may be molded with the wall, and thus by bonding with same make it a part of the wall.

Another method is to mold the ornament separate, with a projecting body or "shoulder." An opening is cut into the wall form to allow this shoulder to be inserted in same, at the point you wish ornament. As this extends into the wall the ornamentation is securely bonded. The placing of ornamental forms of concrete or of dressed stone may thus be made as simple as the use of same in any wall of masonry; thus enabling the contractor to construct walls that are monolithic entirely, and yet carry as much bas-relief work as may be desired. This is a departure from the plain surface that everyone associates with a concrete wall, which has been one of the objections to monolithic construction.

SPACERS FOR REINFORCEMENT

At *D* (Fig. 7) is shown a method of spacing reinforcement in the wall forms. This may be applied with success to practically every type of reinforcing material in use to-day.

Every worker knows that unless the spacers are placed on the reinforcement before the centering is

in position, there is always more or less annoyance in placing same. To employ a wire for this purpose, and bending it in a loop around some part of the reinforcement, requires that a light wire be employed, so it is sufficiently ductile to be easily bent. This is impossible to place only at the top of the forms, as the worker cannot have room for bending same but a few inches below the top edge of centering.

By bending the wire in the form shown at *D* (Fig. 7), a clip is made that acts the same as a paper-clip or a clothes-pin on the reinforcement. All that is needful is to press it down over the reinforcing material to have it grip it tightly, and the wire projecting at each end rests against the forms, and so holds the reinforcement in the exact position desired.

This may be made of a heavy wire, as the bending can be done in a machine, thus avoiding the danger of the spacer bending and allowing the reinforcement to be displaced, as would happen with a lighter wire.

This is also more quickly placed, as the workmen have only to press it down over the reinforcement at the proper intervals apart, to hold same accurately in position against a careless worker or the concrete placed in forms. This also enables the workmen to place the spacers upon reinforcement after the centering is in place, as they can attach same as far down as can be reached from the top of forms.

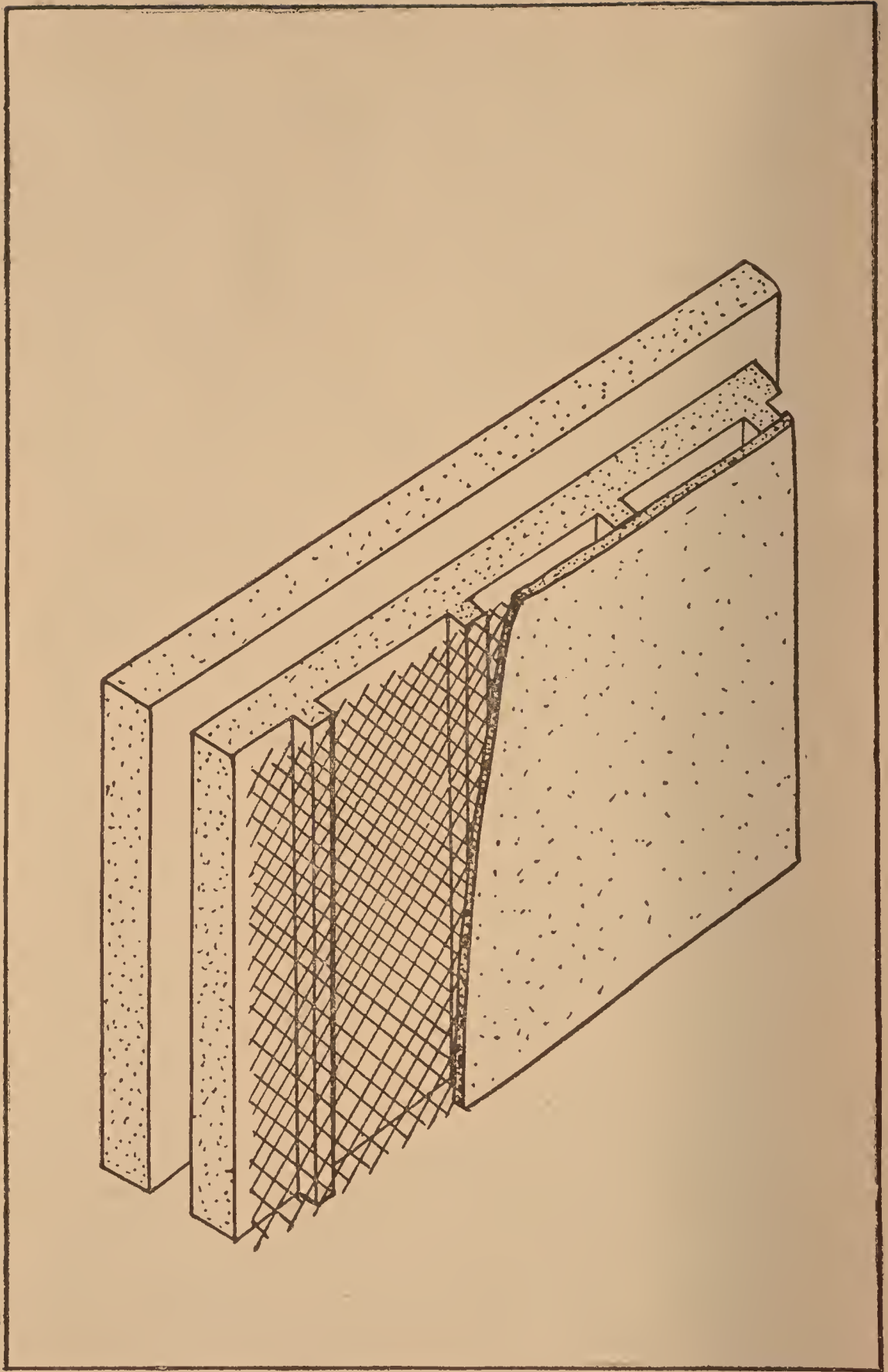


FIG. 8.—Molding concrete furring strips to make a fireproof wall.

MOLDING AN ABSOLUTELY FIRE-PROOF WALL

While many contractors employ the practise of placing plaster finish directly upon the inside walls, where a double wall is constructed, yet the use of furring strips and the metal or wood lath nailed to same cannot but be the more satisfactory, as a second air-chamber is thus made that will serve to resist the cold and dampness, also the reinforcement of plaster with the metal lath makes it less liable to crack and insures a most durable plaster coat.

Where wood furring strips are to be used, they may be either set into the mortar at the proper spacing apart, as the wall is constructed, or they may be attached to the wall by placing in the wall, when molded, wall plugs at the proper spacing, and to these nailing the wood furring strips which in turn carry the metal or wood lath as is used. The latter method is by far the best, as where the furring strips are set directly into the concrete the moisture will cause the wood to swell. Then, when this has resumed its normal state, the strips will be loose in the wall.

**MOLDING CONCRETE FURRING STRIPS WITH
THE WALL**

At Fig. 8 is shown a simple and easy manner of making an absolutely fireproof wall as well as securing the advantages of the second air-chamber between plaster coat and inside wall. The wall forms

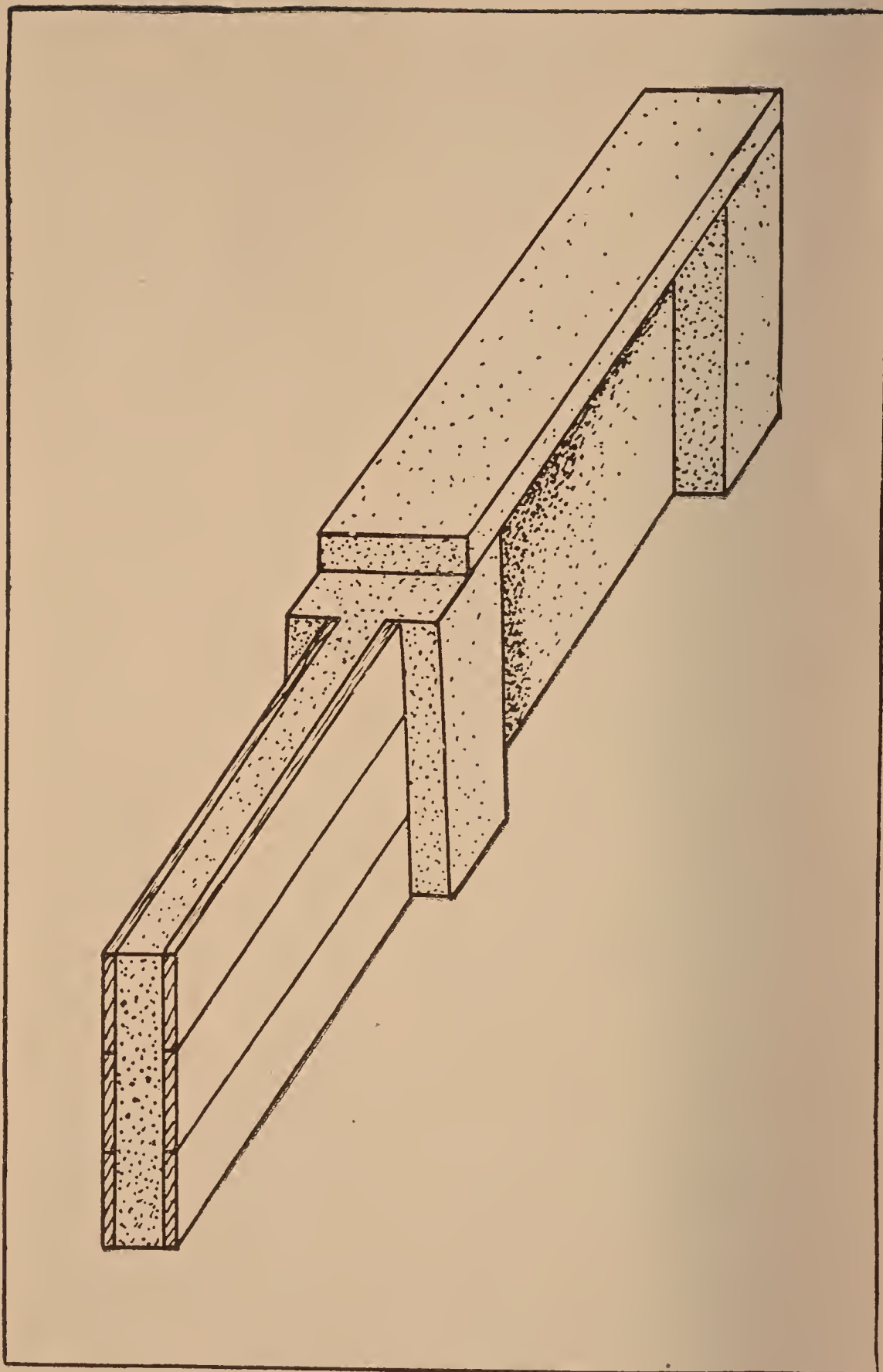


FIG. 9.—An economical system of constructing foundation walls.

are constructed so as to mold a vertical projection of concrete of the size and projection you may wish for the furring. Into these projections wall plugs or shields are placed to receive the nails or staples to hold the wire lath or expanded metal lath in place. This makes it a very easy matter to place the lath and plaster coat without the bother of guarding against the furring strips swelling from moisture and insuring a wall that is not only durable but is absolutely sanitary and fireproof as well.

The cost should be less than the use of separate strips for this work, as the material will be less expensive and the labor in placing is less than to add the furring to the wall later, as with the present method.

AN ECONOMICAL SYSTEM OF CONSTRUCTING WALLS

A large saving in material and expense for forms may be effected by employing the system of wall construction illustrated in Fig. 9, which is adaptable for foundation walls and also such buildings as this type of construction permits its use.

As will be noted, the piers are constructed first and the connecting or curtain walls molded between same. Thus with three or four forms for piers and curtain walls the work need not be stopped; for as fast as the work has hardened the forms can be removed and used again. The forms for piers are set at equal distances apart so that the curtain wall forms

will fit between each one without changes. A groove or recess is also molded in each pier at the point the curtain wall will join same, so as to secure a tight joint. When desired, iron rods may be laid horizontally across the pier. The ends of these rods are bent up for a distance of four to five inches, and when the pier forms are removed and the forms for curtain wall in place, these rods can be straightened again, and thus embed into the new concrete placed and bond same securely with the pier.

The piers are made strong enough to bear the entire weight of the structure with the load it will contain. Hence the curtain wall is only for the purpose of bracing the piers and filling in the space between same. This makes it possible to use curtain walls of 6" in thickness on foundations, as the ground upon which piers are placed is excavated until a secure load-bearing soil is reached and the piers are able to bear the entire weight of building.

The piers should be spaced six to eight feet apart, and this enables the contractor to build forms for his curtain walls that may be employed on many different jobs, as well as requiring but a few forms for the one job, by removing forms and setting up again between the piers as fast as the work has hardened.

This makes a slight cost for lumber as well as a less expense in moving the forms from one job to another, without any material waste of lumber in building new forms each time.

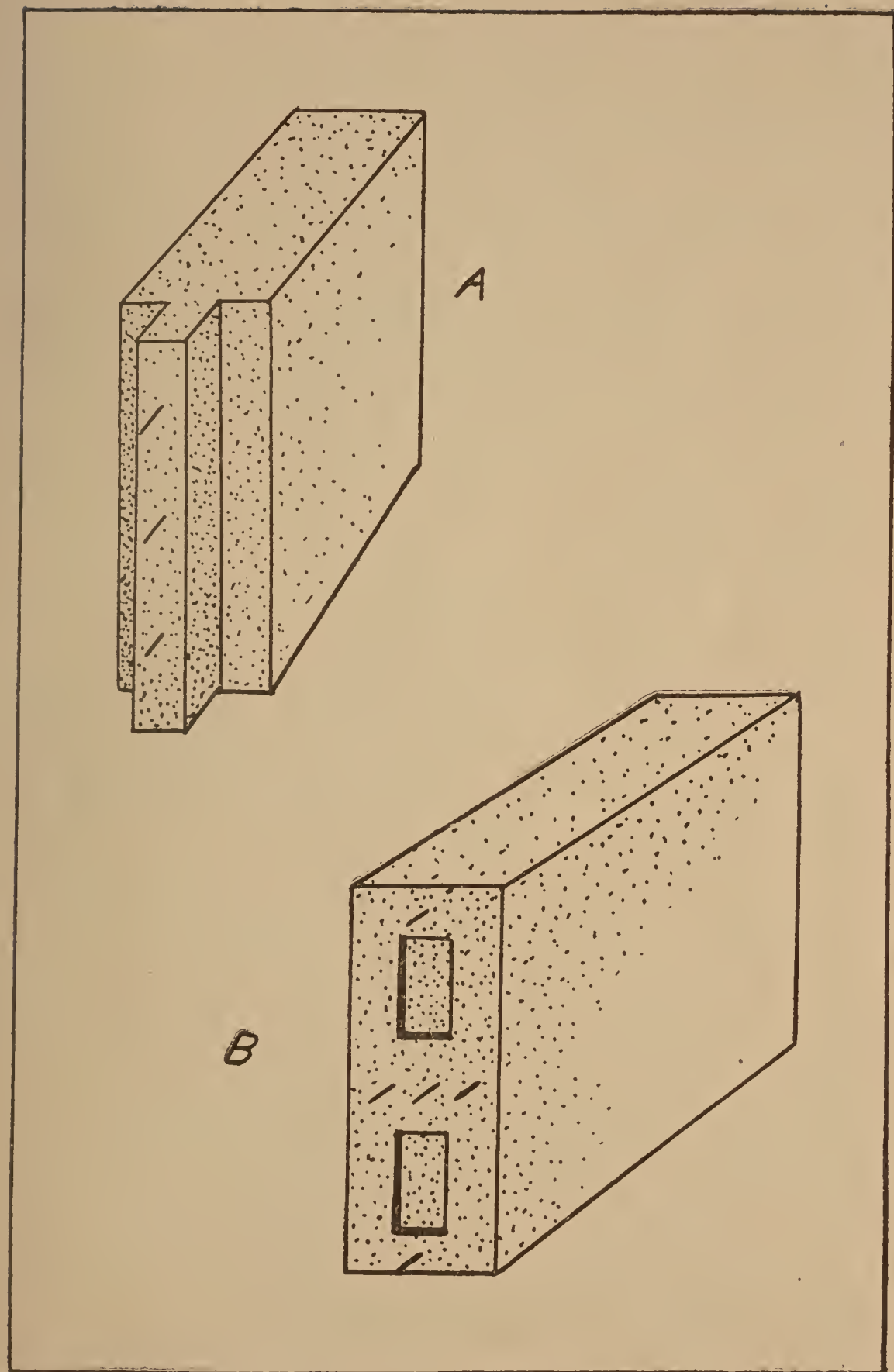


FIG. 10.—Joining sections of walls together.

The appearance of this form of wall is more pleasing than a plain straight wall, with its many advantages when placing a new foundation wall under an old building. In this case the piers may be constructed, and when finished the building placed upon same, or the building blocked up to the level it is to occupy and the piers constructed up to that level. This permits all blocking to be removed, and a clear field left for the placing of the curtain walls, which may be of monolithic construction or brick, hollow concrete blocks, or of stone or rubble concrete, as may be desired.

The water-table, as shown in Fig. 9, is easily molded of the thickness desired when the piers and curtain walls have become self-sustaining, and adds to the appearance of the walls by dividing it into panels, as well as aiding it in dividing the load of building between the piers.

JOINING TWO SECTIONS OF WALL TOGETHER

At Fig. 10 is shown two methods of joining sections of wall together, so as to secure a good bond of the concrete.

The method shown at *A* (Fig. 10) requires the forms to be constructed so as to mold a projection upon the end of each section of wall, as illustrated. This is further strengthened by placing iron rods as keys or projecting stays. These rods project so as to embed into the concrete of next section from 6" to one foot, thus tying the two sections together.

This form of joint makes a perfect protection against the shrinkage of the concrete in drying, as the projection upon one section of wall locks or projects into the other, making a tight joint. In drying, concrete will shrink from $\frac{1}{16}$ " to $\frac{1}{4}$ ", depending upon whether a semi-moist or slush mixture is used, thus making this or a similar method of securing a tight joint necessary.

The method shown at *B* (Fig. 10) is also of value, and is of use on foundation walls, retaining walls, or dam construction, where an absolutely wind-proof joint is not a necessity. The use of iron rods or projecting keys are shown in illustration. These may be bent upward, to lie along the end of wall form, when the concrete for first section is being placed, then bent down to a horizontal position when ready to place the second section of wall. Instead of a projection a recess or panel is molded into the wall. This may be in the form shown in illustration, or may extend vertically the entire height of wall. This recess is very easily molded by attaching a wood strip of the right size to the inside surface of the forms, at the point desired. This may be square, oval, or triangular in shape, and by attaching to the forms with screws may be thus easily removed when there is no need for its use.

BONDING CONCRETE BY THE USE OF ACIDS

Where the two methods above will not meet the requirements, or in case plaster is to be applied upon

an old wall, the acid treatment will aid in securing a perfect bond.

The wall is first thoroughly cleaned of all dirt and foreign matter, by scrubbing with water and a stiff broom. The commercial muriatic acid or hydrochloric acid is mixed with four parts of water and applied to the wall. It is often necessary to use several applications of the acid, depending upon the age and condition of the surface to which it is applied. The acid bath removes the thin coating of cement from the surface of the aggregate in wall, and at the same time cleans this surface so that the new concrete has every chance to bond to same.

After the acid has been applied, and within a few moments, the wall should be thoroughly washed with clear water to remove all traces of the acid, and the dead particles it has etched from the surface. The acid will not injure the concrete, as it cannot sink to a sufficient depth before it is neutralized by the bath of clear water, which entirely removes same.

The surface of the wall should be thoroughly wet before the new concrete is applied, and where this is in a thin coating, as plaster, etc., the wall must be kept damp for a week at the least. This can be accomplished while the concrete is green by hanging a wet blanket up against the wall; and when the mortar has hardened the wall may be wet down with a hose. By following this method the new concrete will bond as securely with the old as if both were mixed and placed at the one time.

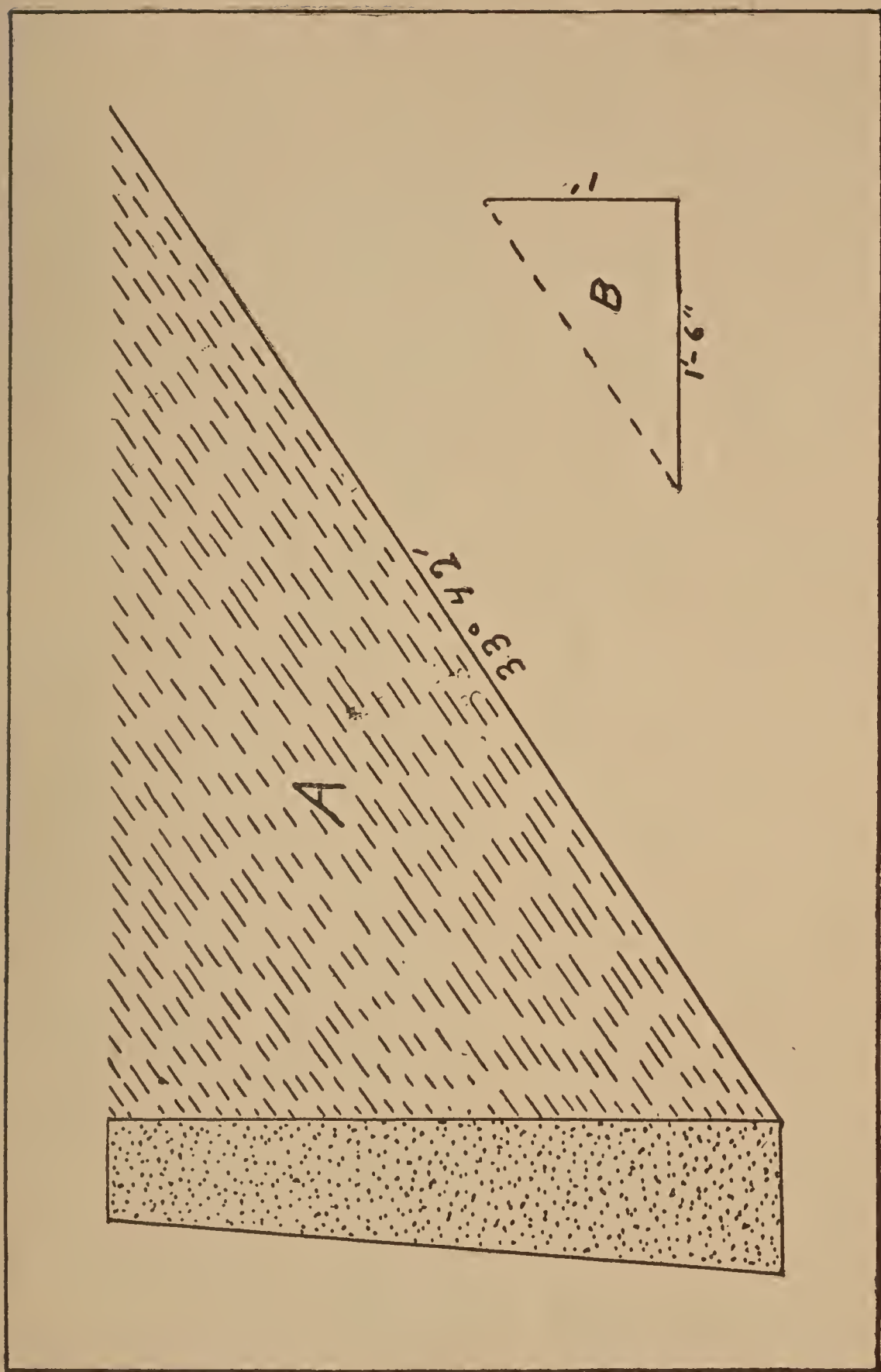


FIG. 11.—Diagram illustrating the natural slope of earth, or angle of repose.

RETAINING WALLS

The worker that builds wall forms should have a knowledge of the various forms of retaining walls, and the reasons for their construction. In constructing a retaining wall to rebut the pressure of earth as well as in designing same, attention must be given to the character of the material to be retained.

Where any granular material is unconfined it spreads out to its natural slope or position. This is termed the angle of repose, or the position in which it will safely lie without any force to restrain it. This angle varies with the material and also with the amount of moisture in same. Thus with common earth the natural shape is an angle of about 40 degrees, while with wet clay the angle is taken at 15 degrees; and when this is dry, the natural shape is an angle of 45 degrees. Gravel has the same natural slope as common earth of 40 degrees, which varies according to the moisture in same. Where the material is a form of rock in its natural formation, the retaining wall need be but a face wall.

The usual angle taken by engineers for all classes of earth is that formed by a prism which is 1', 6" horizontal to each 1' vertical measurement. This corresponds to an angle of 33 degrees 42 minutes, as shown by the illustration in Fig. 11.

As illustrated at A (Fig. 11), the pressure upon the retaining wall comes entirely from the prism of earth shown by the dotted lines, hence the entire

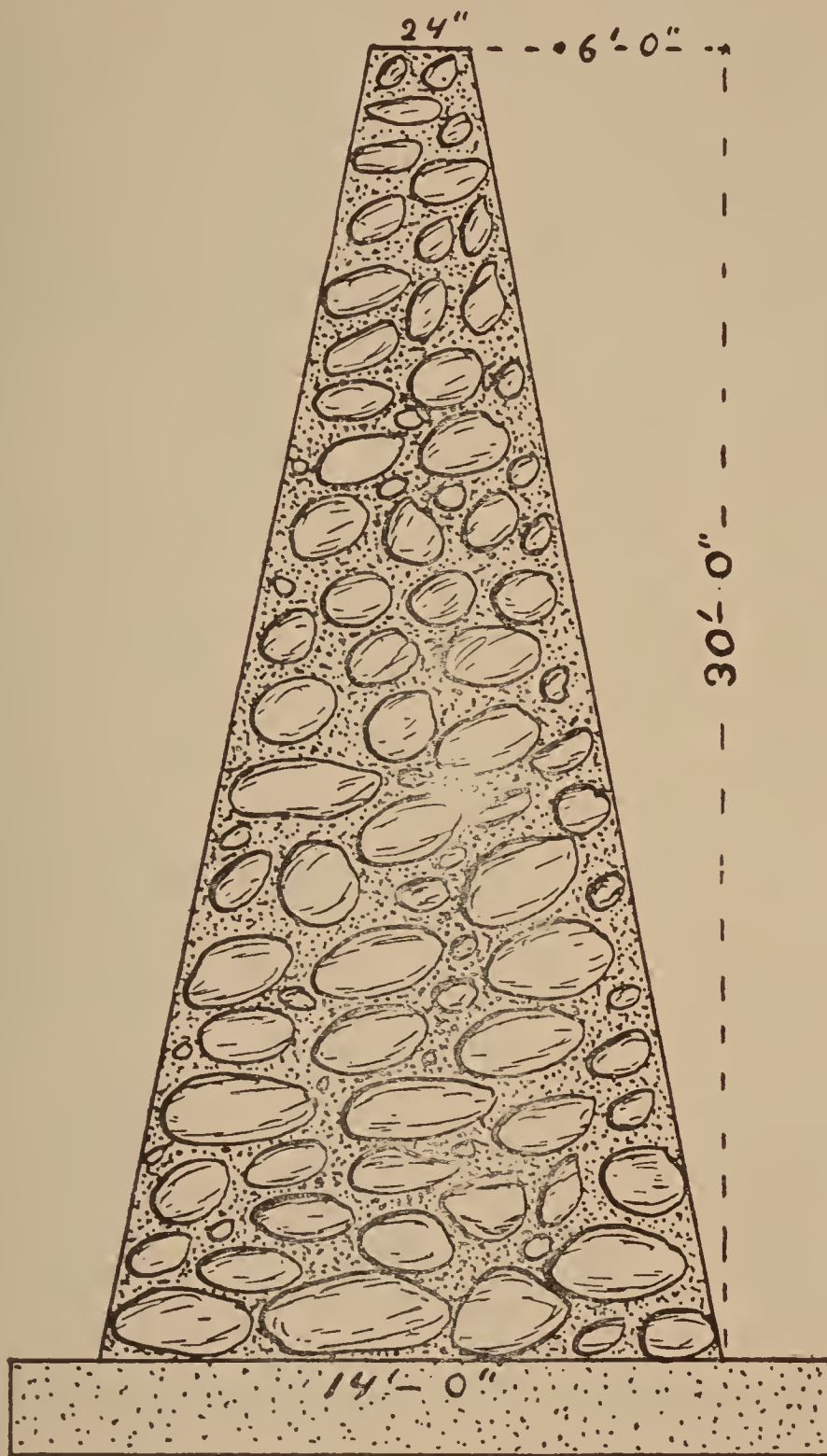


FIG. 12.—Retaining wall of rubble concrete, blocks or masonry.

purpose of the wall is to retain that section of the earth.

In proportioning the walls there is a great diversity of practise, depending upon the type of wall and the material it is to retain. The usual practise is to have the base of wall from .3 to .5 of the height, the latter being the greatest required under any but the most unusual conditions.

The foundations should be secure against the action of frost and the natural drainage of the earth back of wall should be provided for by tile laid back of wall or through same, so that there is no danger of the wall damming up the drainage of the soil.

The back of wall next to the earth may be left rough, so as to increase the friction between the wall and the filling of earth behind same; also by coating with some waterproofing material to prevent the water soaking into the wall, it will be greatly benefited.

At Figs. 12, 13, 14, 15, and 16 are illustrated some of the usual types of retaining walls with the proportions for same, which will be of value to the worker in constructing forms for various types of retaining walls.

The wall shown at Fig. 12 is employed when the material is stone-masonry, concrete blocks, or rubble concrete. With a total height of 30' the base is 14' and the top of wall 24", thus giving a batter or slope to the wall of 6', or one foot batter to each five feet

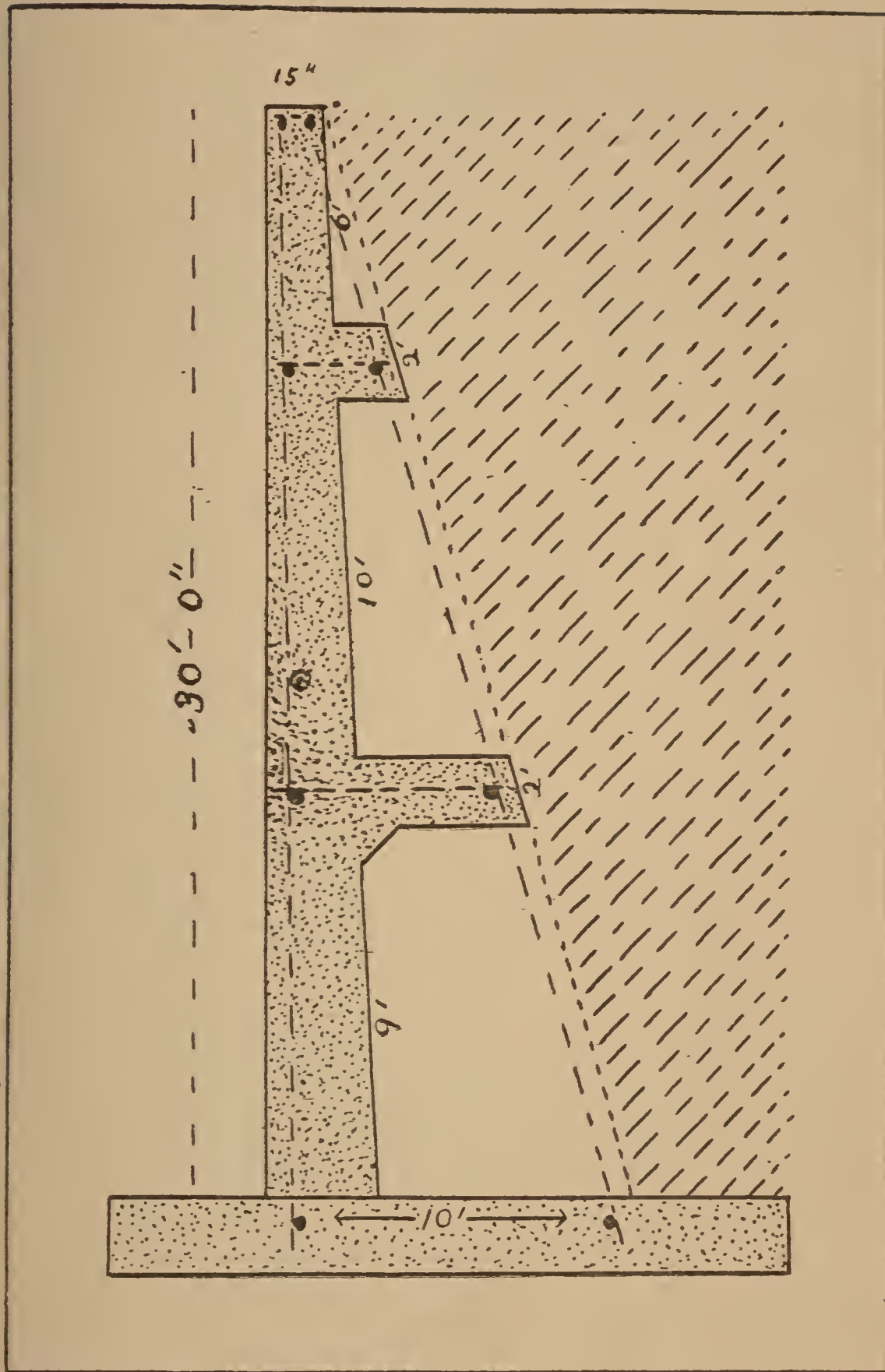


FIG. 13.—Reinforced concrete retaining wall with vertical face.

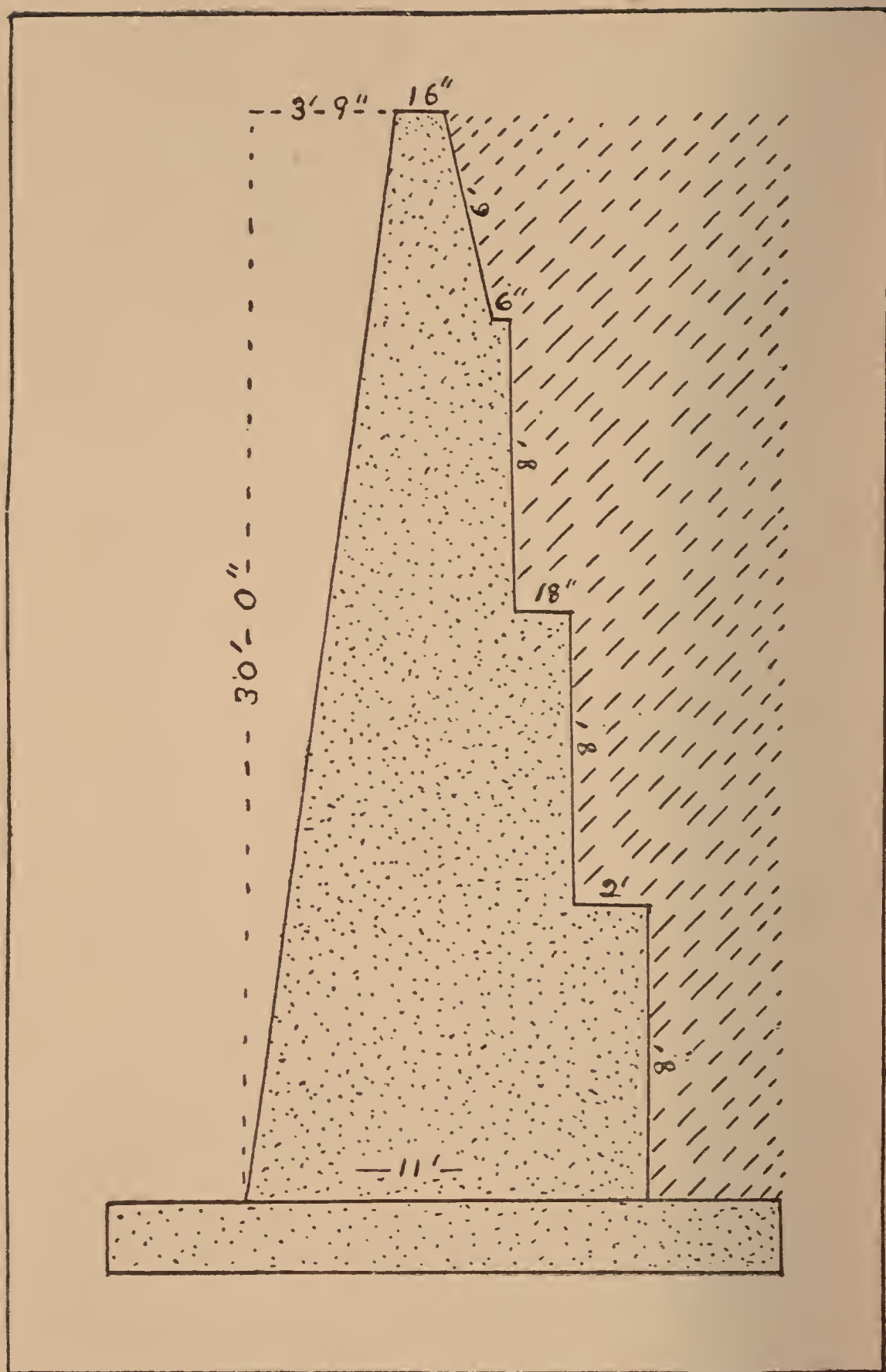


FIG. 14.—Plain concrete retaining wall.

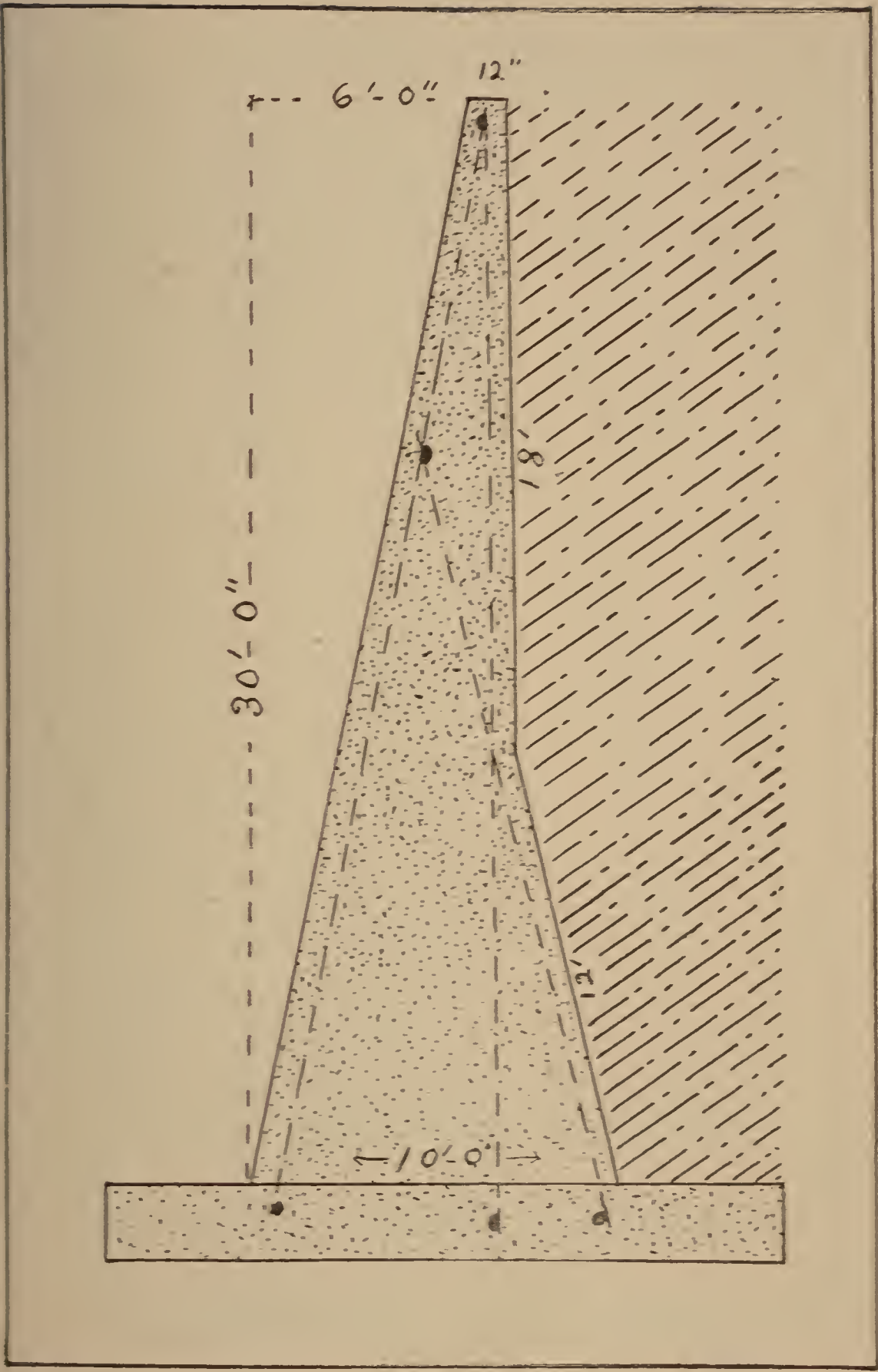


FIG. 15.—Batter faced, reinforced concrete retaining wall.

in height of wall. This makes an excellent type of wall that is very easily constructed.

At Fig. 13 is illustrated a type of vertical face reinforced wall. This is usually constructed with wing walls at each 10' of its length. The total width of these wing walls is 10', while the thickness of the main wall base is 3' when the height is 30'. The thickness of top is 15", with a reinforcement of two 1" rods laid horizontal. These are connected with rods to six other 1" rods, laid horizontal in the concrete of wall, as shown in illustration.

The type of plain concrete wall shown at Fig. 14 has a base of 11' in thickness, with the top 16" in thickness. The batter on the face is 3', 9", which is equal to one foot for each 8 feet of the height. Upon the earth side the wall rises vertical in three 8' steps, which are 6", 18", and 24" in width. The top is finished with a slant of 6' in height, as illustrated.

The batter face reinforced concrete wall shown at Fig. 15 has a base of 10' in thickness with the top 12" thick. The batter to face is 6', or 1 foot for each 5 feet of the total height. The wall is reinforced with five 1" horizontal rods, and these are connected with vertical rods, as shown by the dotted lines in illustration. The upper portion of the wall is vertical on the earth side for 18', while the lower 12' of wall has a batter of 3' on this side.

The reinforced concrete wall shown in Fig. 16 is constructed with a counter-fort or wing wall for each 10' of its length. The thickness of this wing wall at

base is 9', 6", while the thickness of the base of main wall is 2', 6". The width of wall at top is 14", for a wall 30 feet in height. The batter of the face is 3', or equal to one foot for each 10 feet of the height. The concrete is reinforced with five rods laid horizontal. These are 1" in diameter, and are connected by 1" rods in the manner shown by dotted lines in illustration.

The details shown in the last five illustrations will be of value to the concrete worker who is called upon to erect forms for a retaining wall, as well as in erecting such walls.

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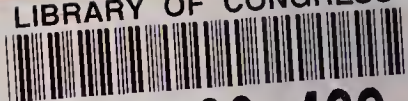
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